Mapping Floods due to snowmelt and ice jam in Alaska Area using NPP VIIRS data

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Background

Since the Northeast and North Central U.S., and some areas of the Western U.S. are particularly susceptible to snowmelt and ice-jam flooding, to meet the needs of end-users, special attention and applications have been made to snow/ice melt flooding. The USGS and NOAA/NWS can provide river flood forecasting within the United States, but not over land. Satellite-derived flood maps in near-real time (NRT) are invaluable to stake holders and policy makers for disaster monitoring and relief efforts.

Objective

In this study, we use NPP VIIRS 375-m Imager to detect flood information caused by ice-jam in the Alaska area. The results shows satellite data like NPP VIIRS is very useful to flood detection in data sparse high latitude region.

Here we show an example for a severe flood occurred along the Yukon River in Alaska from May 27 to early June, 2013 due to an ice jam. The city of Galena was affected the most by this flood. Most of the town was flooded, and hundreds of people were forced to evacuate. After the flood, Galena was unsafe for a long time due to the destroyed infrastructure, such as power lines.

Figure 1 The submerged community of Galena during the flood

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Water Fraction Retrieval

Dynamical Nearest Neighboring Searching Method (DNNS) (Li et al., 2013)

$$\frac{R_{ch1\_mix}}{R_{ch3\_mix}} - \frac{R_{ch1\_water}}{R_{ch3\_mix}} < \frac{R_{ch1\_land}}{R_{ch3\_land}} < \frac{R_{ch1\_mix}}{R_{ch3\_mix}}$$

$$\frac{R_{ch2\_mix}}{R_{ch3\_mix}} - \frac{R_{ch2\_water}}{R_{ch3\_mix}} < \frac{R_{ch2\_land}}{R_{ch3\_land}} < \frac{R_{ch2\_mix}}{R_{ch3\_mix}}$$

$$f_w = \frac{R_{ch\_land} - R_{ch\_mix}}{R_{ch\_land} - R_{ch\_water}}$$

The entire flood was monitored dynamically with the Suomi-NPP/VIIRS data using the algorithms developed in this research. The following figures show a series of VIIRS false-color images and the corresponding flood detection maps from May 27 to 31, 2013. In the flood detection maps, blue represents normal water, white represents snow/ice, light gray represents clouds, dark gray represents cloud shadows, and colors from cyan to red represent different water fractions of flooding.

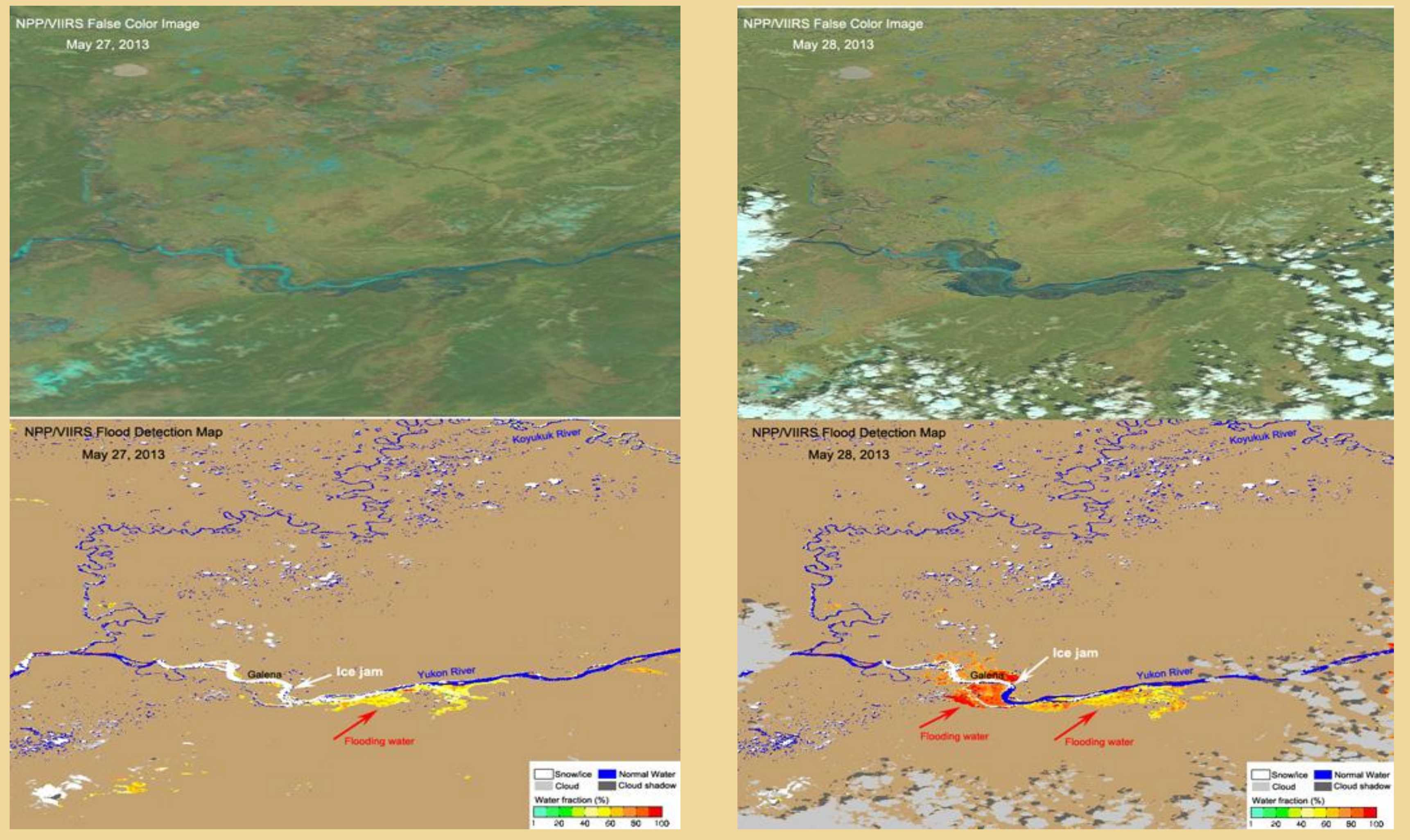

Figure 2. VIIRS 375-m false color image and the corresponding flood detection map near Galena on May 27 (left) and 28 (right), 2013.

Flood Maps Derived from the NPP/VIIRS

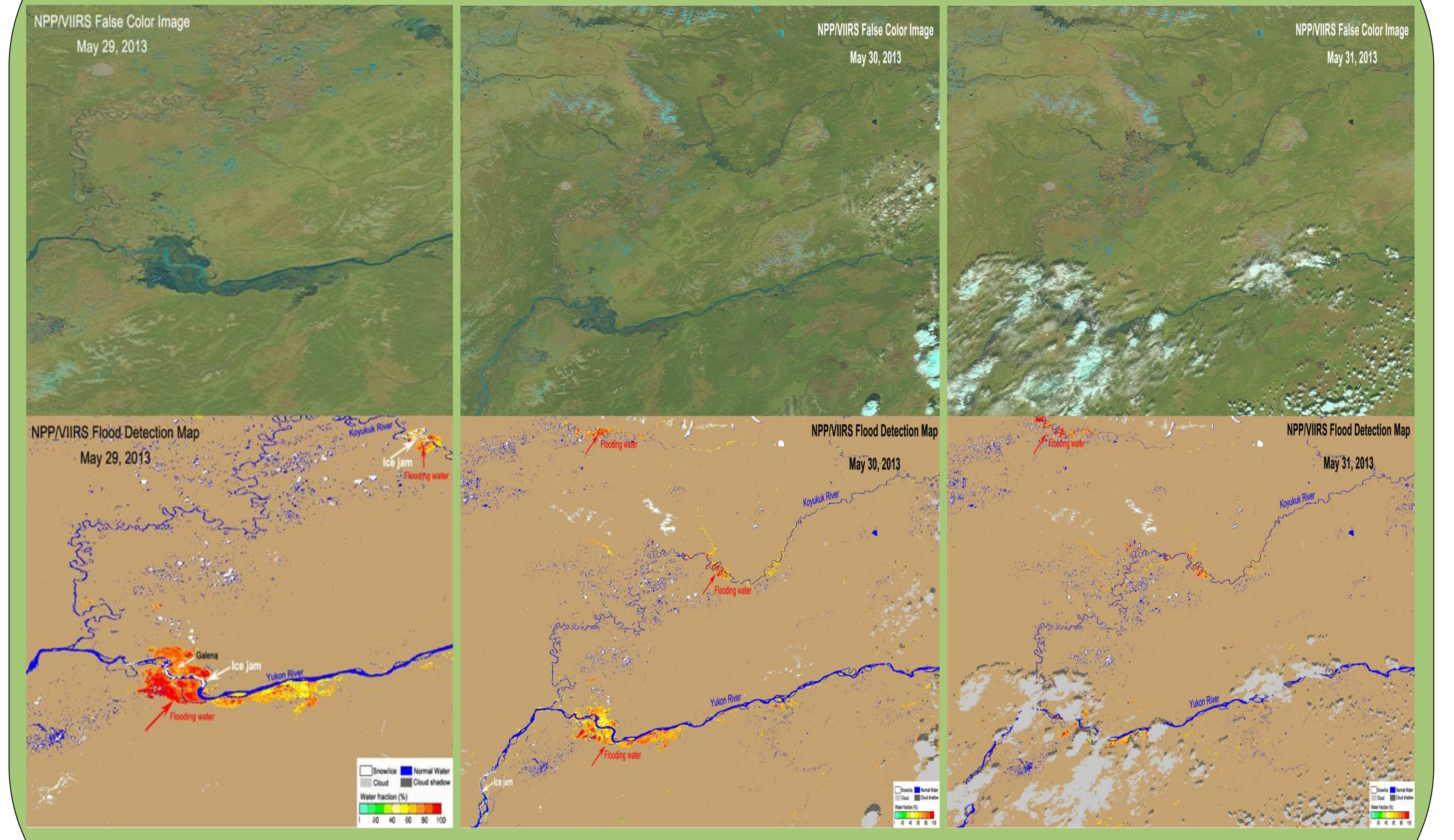

Figure 3. VIIRS 375-m false color image and the corresponding flood detection map near Galena on May 29 (left), and 30 (middle), and 31 (right) in 2013.

Summary

The high temporal resolution and large coverage of coarse- to moderate-resolution satellite imagery, such as the NPP/VIIRS, are very advantageous for flood monitoring. The VIIRS flooding detection results were validated with the aerial photos and news reports. The flood retreat time and locations from the VIIRS observations were consistent with those recorded in the media reports. The comparisons with the visual inspection from the VIIRS false color images also showed good accuracy and consistency. The VIIRS-derived flood maps had advantage over the visual inspections in the detection of this kind of flood, which occurred rapidly over a large area, especially in the high latitude region with sparse conventional observations, like the Alaska.

Acknowledgements

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Reference

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